

material bearing on the physics and biology of the waters has still to be published.

The bathymetry of the lake-basins was determined by series of close soundings in lines transverse to the long axis, and the scale of the maps is sufficiently large (3 inches to 1 mile) to allow of all the soundings being represented in figures as well as by contour lines. We think that a longitudinal line of soundings along the axis of maximum depth would have been a useful addition in all cases, and a valuable check on the transverse series. Supplementary soundings would also have been useful in many places where the exceptional run of the contours suggests some unusual configuration. Such additional lines have been run on some of the lochs, and the maps of these inspire a more complete confidence as to detail than do the others. We should have liked to see some larger-scale surveys of such individual features as the sub-lacustrine slopes of delta fans, scree, steep rocky shores, and the transition belt between the steep sides and flat floors of many of the basins.

The sounding of the large area of fresh water which fell between the two stools of the Admiralty and the Ordnance surveys is a splendid example of public-spirited private enterprise undertaking and carrying through work which should have been included in the routine of a Government department. It is, happily, not the only case in which the collective shortcomings of the nation in matters affecting the advancement of scientific knowledge have been made good by individual effort and at private expense. When the right men are at the head of such an investigation, and their labours are not trammelled by the want of means, we are of opinion that better work can be done at a smaller outlay than if the operations were conducted by an official department or under the auspices of a committee of many specialists on different subjects; but when the right men are not to be found the lack of Government interest in the completion of our knowledge of our own land and its resources may lead to unhappy consequences. It is fortunate, indeed, that Sir John Murray and Mr. Pullar have had both the will and the power to carry out the work, which, when completed by the publication of the additional material already collected, will form a noble monument to the memory of the late Mr. Fred Pullar, to whose energetic assistance the early stages of the research were so much indebted.

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THE OLD AND THE NEW MECHANICS.

- (1) *A First Dynamics*. By C. S. Jackson and W. M. Roberts. Edited by W. J. Greenstreet. Pp. viii+412. (London: J. M. Dent and Co., 1909.) Price 5s.
- (2) *Elementary Mechanics*. By Prof. C. M. Jessop and Dr. T. H. Havelock. Pp. viii+277. (London: George Bell and Sons, 1909.) Price 4s. 6d.

(1) SO many new series of mathematical school-books have appeared during the last few years that the present series has remained almost unnoticed. This is the more remarkable in view of the wide reputation of the editor, Mr. Greenstreet, and also of

the fact that the contributors are also mostly well-known authorities in the mathematical teaching world. Messrs. Jackson and Roberts have fully justified the existence of their book by the amount of freshness and originality they have put into it, and particularly by the extent they have treated the subject from a common-sense, practical point of view. As the authors point out in the preface, there have been in the past two classes of book in which the relations between force, matter, and motion are dealt with. There has been, first, the book on applied mechanics, in which the principal object has perhaps been to describe machines, and there has next been the "academic" book, in which dynamics might perhaps better be described as "dogmatics," the most prominent feature of which has been a collection of exercises in algebra.

It has been the object of the present authors to make the principles of dynamics the prominent feature of their book, and to illustrate them by applications to phenomena of everyday life rather than by algebraic drill. In this they have been very successful, so far as can be judged without an extended trial of the book in the class-room.

The main crux in writing a book on dynamics is the question of units. Shall the author use poundals and please one class of teachers, or shall he use slugs and be commended by another section? It seems to have been generally forgotten that there is a third alternative which still allows those who wish to do so to replace Newton's "proportional" by "equal" in the laws of motion. That alternative is to take the gee (g) as unit of acceleration, and write force in lbs. wt. = mass in pounds and acceleration in gees; and if any writer chose to champion the claims of the gee, he could point to the fact that the foot, if defined by the length of the seconds pendulum, is really a gravitation unit of length.

Messrs. Jackson and Roberts, while discussing the two generally recognised systems, adopt the more rational plan of basing their treatment on the proportion:—

$$\frac{\text{force}}{\text{weight}} = \frac{\text{acceleration}}{g}.$$

It has been popularly supposed that this plan is theoretically good, but how would the equations of motion of complicated systems be written? Now in Mr. Jackson's hands the equations all look delightfully simple; not only is there no more difficulty than occurs somewhere in every system, but *it is very easy to see if the results written down are correct in their dimensions*. The suppression of constant multipliers in physical equations does not always conduce to simplicity; it more often causes confusion, especially in connection with electrostatic and electromagnetic units, and also in hydrodynamics, where problems of discontinuous motion are solved for jets of one particular breadth (generally π) with one particular velocity, and the solution appears inapplicable to other jets differing in size and velocity. A little doubt may occur as to whether momentum should be defined as Wv/g , as Mr. Jackson does, or simply as Wv ; but this is a matter in which experience will indicate the wisest choice.

The subject-matter treated includes such applications as the instantaneous centre of a connecting rod, two-speed gears, and the elements of dynamics of rotation. There are many reasons why the latter subject should be included in an elementary treatise; indeed, the authors claim that, "frankly, unless a student means to know, in broad outline, about as much of the principles of mechanics as we have given, he may with advantage allot more time to some other subject."

In certain details the book leaves something to be desired. It would surely be better, for example, to give the rule for composition of relative velocities after, instead of before, the construction for the relative displacement and velocity of two moving bodies. The present order is a survival of the old idea that because the parallelogram of forces is the fundamental proposition in statics, the parallelogram of velocities ought to be the fundamental proposition in kinematics. In the proof of the relations between angular and linear velocity, a 60 is introduced unnecessarily and then cancelled by considering the space described in a minute instead of in the unit of time (a second) assumed in the definitions. In several places where uncertainty exists as to how much should be included in the text and what should be omitted, the final result suggests that the authors were not given sufficient facilities for making alterations when the proofs were in type. The paragraphs are unnumbered, and this is a great drawback, but the worst feature is the illustrations, which are badly reproduced, with coarse, unsightly lettering. In one of them, on p. 177, a capital V looks like a Greek γ . If books of this class are to hold their own in the field of competition, not only should the figures be above reproach, but a large amount of time and thought must be devoted to minor alterations and emendations such as only suggest themselves when the text has been seen in print.

(2) If novelty and originality is one of Mr. Jackson's strong points, this cannot be said of Prof. Jessop and Dr. Havelock's book. It brings back to memory days of long ago, with its "forces of 1, $\sqrt{2}$, and $\sqrt{3}$ lbs.," its Roman and Danish steelyard, its three classes of lever, the oar being included in the second regardless of the man's thrust on the rowlock, its mechanical advantage instead of the more modern velocity ratio and efficiency, its systems of pulleys which only lift a weight a small fraction of the height of the supporting beam—and perhaps do not lift it at all if the ropes are extensible, and its Attwood's machine neglecting inertia of pulley, in the first instance, although this is now taken into account at the end of the book. But Jessop's "Elements of Applied Mathematics" was an excellent book when it was written, and it is not the book which has gone backward in its present revised edition, only other people have moved forward. Moreover, the present reviewer can ill afford to find fault with an author who is prevented by his professorial duties from completely rewriting his text-books when his opinions on certain points have changed. At the same time, in view of the fact that revision has been undertaken by Prof. Jessop's lecturer, we think something more might

have been done. The separate formulæ for the resultant at angles of 30° , 45° , and 60° might surely be struck out *now*, although the present reviewer pleads guilty of having perpetrated the same barbarisms (under protest) when he was younger and was informed that certain classes of students required them. On the other hand, the addition of sections on harmonic motion, bending moment, and shearing force (under graphical statics), and the chapter on energy of rotating bodies are valuable additions. In the latter chapter the moments of inertia of simple figures are stated without proof. Perhaps this is the best way, in view of the fact that integral calculus is now usually taught at an early stage; had this not been the case, the use of the geometric progression formula for making the necessary summations would have been recommended.

A student might do worse than use Prof. Jessop's book for algebraical drill, supplementing it by a course of experimental mechanics, or by Mr. Jackson's book; and whatever else may be said, no exception can be taken to the general appearance of the book, or the diagrams, which fully maintain the high standard that characterises Messrs. Bell's text-books.

OUR BOOK SHELF.

The State and the Farmer. By Prof. L. H. Bailey. Pp. xii+177. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 5s.

LESS than a generation ago farming and farmers made very small figures in the public eye; men of affairs, when they gave the subject a thought, regarded British agriculture as a dying craft, something that had ceased to pay and might be left to extinguish itself quietly, leaving the country for the recreation of the town-dweller, to provide sport for the rich industrial, health and the gratification of his æsthetic tastes for the employee. Business men paused sometimes to make pharisaical remarks about the wastefulness of the farmer; men of science scolded him for sticking to his old ways, not adventuring his substance on the crude generalisations which were put forward to represent the infinitely complex life of animals and plants; the politician had no use for the agriculturist, whose vote he knew was safe in the landlords' pockets; and the journalist saw little but comic copy to be got out of Hodge and its ways. As Sir Horace Plunkett said in his British Association address, modern civilisation has joined the rural exodus.

But latterly there have been signs of change; the triumphal march of industrial progress, with its concomitants of vaster factories and ever extending suburbs of mean streets, has proved less satisfying than its prophets had promised; the nation has begun to awake to the essential instability of such a system, and to the need of keeping up agriculture as the soundest basis of the State and the only means of creating wealth, whether of men or things.

To some men the necessity of drawing men back to country life seems little less than a holy cause into the service of which they are ready to put their whole strength, and among such men Prof. L. H. Bailey, of Cornell, is perhaps most prominent on the other side of the Atlantic. In the little book before us Prof. Bailey pleads for the better organisation of rural life with eloquence and conviction; rural life, not merely because it pays, but because it is the life best worth living, most calculated to raise a sober and